EFFECTS OF FLY ASH STABILIZED SOILS IN LIVESTOCK PENS ON ANIMAL PERFORMANCE

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Introduction

The climate for cattle feeding and general livestock production in the Northern Plains is very suitable during 9 or 10 months of the year. Sever cold can be mitigated by wind protection, bedding, and nutritional programs for both feedlot cattle and cow herds. Mud, however, is problematic during spring thaw and summer rainfall events.

Fly ash produced from coal combustion in electricity generating power plants in the region is known to have cementitious properties. It is widely used as a substitute for up to 20 percent of Portland cement in readymix concrete. It is also placed in roadbeds to stabilize the soil in areas with marginal stability. The use of fly ash to stabilize soils in livestock pens has been investigated by a collaboration of scientists from industry, UND, and NDSU at the Carrington Research Extension Center during the past few years. One of the key components in permitting the use of fly ash in livestock pens is the potential benefit to animals and in economic terms for producers. This paper presents data on comparative animal performance for bison fed in pens with fly ash added vs. no fly ash during the first year of placement.

Materials and Methods

Bison bull calves (n=80) were placed in newly constructed feedlot pens in January 2001 and fed for six months on this trial. Ten animals were randomly allotted to each of the 8 pens used in this study by gate cut during initial animal processing and weighing. Four of the pens were prepared using fly ash from Coal Creek Station in western North Dakota at 12 to 26 percent of the soil volume in the top 8 inches of the pen surface. Four of the pens received no soil amendment and were constructed using clay material and packed by multiple passes of earth movers. Fly ash was incorporated into the "treated" pens using a box scraper to spread the product evenly, and a rototiller or tandem disc to mix the fly ash with soil. Fly ash was transported to the construction site in hopper bottom grain trucks. The final moisture level of 12 to15 percent was achieved by adding water prior to and during mixing. Following mixing, the surface was packed using repeated passes with a farm tractor or an eight wheel roller packer borrowed from the county highway department. The fly ash pens were not used for several weeks after incorporation to allow for completion of any chemical reaction.

Bison were fed a totally mixed diet in fenceline bunks to appetite daily. The corn based diets were 75 percent concentrate with 25 percent chopped forage. Bison were weighed individually at initiation of the trial in January, and at approximately 90-day intervals. Period 1 extended from mid December through mid February while Period 2 concluded in mid May.

This study was conducted using bison bulls as new pen construction for bison research allowed for the incorporation and testing of fly ash and bison bulls are more active than beef cattle in the pens, allowing for faster observation of pen surface durability.

Data were analyzed using SAS GLM procedures with pen as the experimental unit. There were four pens (replicates) in each of the two treatments and two weigh periods. Significance is reported when P=.05 or less.

Results and Discussion

Feed intake (Table 1) was not different for bison in the different pens throughout the study. Gains were similar during the first weigh period which included the winter months of January through March when the ground was frozen. During period 2, April, May, and June, when spring thaw and several summer rainfall events occurred, bison gains were greater (P<.05) in the fly ash pens (1.88 vs. 1.53 lb/hd/day). During the entire 6 month period,

gains were greater (P<.05) in the fly ash pens (1.80 vs. 1.65 lbs/hd/day). Feed efficiency was not different during period 1 but improved (P<.05) during period 2 for fly ash penned bison (13.09 vs. 10.40 lbs feed/lb gain). Feed costs per pound of gain reflect the improvement in gain and feed efficiency for animals housed in dryer pens with a reduction in feed cost per pound of gain of $.13 during the muddy period and $.06 per pound of the entire feeding period.

Table 1 Performance of bison bulls in pens with soil or fly ash-soil mixtures.

	Treatments			
Item	Control	Fly Ash	Std Err	P Value
Initial Avg Wt, lbs	639[a]	627[b]	3.69	.02
Dry Matter Intake, lb/hd/d				
Period 1	13.71	13.53	.11	.27
Period 2	20.04	19.56	.21	.15
Overall	17.41	17.06	.13	.11
Avg Daily Gain, lb				
Period 1	1.78	1.72	.05	.53
Period 2	1.53[a]	1.88[b]	.05	.01
Overall	1.65[a]	1.80[b]	.04	.02
Feed Efficiency (feed/gain)				
Period 1	7.70	7.78	.41	.63
Period 2	13.09[a]	10.40[b]	.29	.01
Overall	10.55[a]	9.47[b]	.30	.05
Feed cost/lb gain, $				
Period 1	.37	.40		
Period 2	.59	.46		
Overall	.49	.43		

a, b values with different superscripts are significantly different (P<.05).

Photograph 1 depicts bison in the pens during spring breakup of 2002. Photograph 2 shows pen surface during June of 2003 after a two week rainy spell when beef heifers were penned in the same adjacent lots.

Photo 1. Control vs. fly ash pens during spring thaw after the first winter of placement.

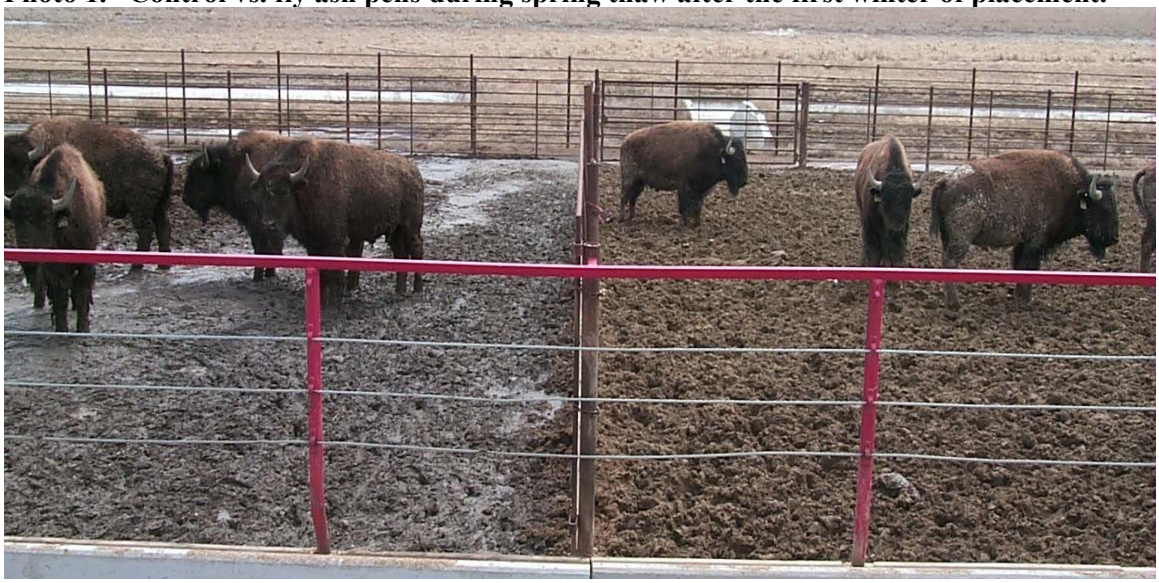

Photo 2. Control pen vs. fly ash pen surfaces 3 years after placement following a two week summer rainfall period.

The results suggest that fly ash impregnated pens will provide for improved production from dryer conditions. Longevity of the surface is still under investigation but after three years of use, surface wear appears to be minimal in the fly ash pens. Approximately 4-6" of soil material has been removed in the control pens due to hoof penetration and mixing of manure into the soil. When the pens were cleaned, approximately two to three times more volume of "manure" was removed from the control pens than the fly ash pens. This mixing and subsequent removal accounts for the lowering of the pen surface in the control pens as indicated in photograph 3.

Photo 3. Erosion of surface of control pen vs. fly ash pen after three years in place.

Economic returns to the use of fly ash are highly positive for animal performance. The magnitude of the improvement for bison may be less than would be expected for beef cattle. Additional advantages may be from reduced pen maintenance, lower volume of manure/dirt mix removed from the pens, and less material for backfilling eroded areas behind cement pads, and along fencelines.

Implications

The recent approval of fly ash for use in livestock pens will enhance animal production in North Dakota if producers place the product as described and manage their animals at a professional level. This practice will reduce but not eliminate environmental stress. The abundant supply, competitive pricing, and multiple locations for sourcing the material make the use of fly ash on farms and ranches very practical. The simple incorporations steps described in detail in another publication give cattlemen confidence that this product can be incorporated into new or existing livestock pens with common farm equipment.